Spatial-temporal City-scale Congestion Prediction using a two-stream Graph Neural Network

7th place solution of the Traffic4cast 2022 core challenge

Ye Wei, He Haitao and Hui Fang

Data Preparation

We trained three models for Melbourne, Madrid and London, and directly used the data loader provided by the organiser. In the training process, we use all data provided, i.e., containing data for non-working time periods.

City	Size of training set	Size of graph
Melbourne	106*92	49510 nodes, 94871 links
London	110*92	59110 nodes, 132414 links
Madrid	109*92	63397 nodes, 121902 links

Training Settings

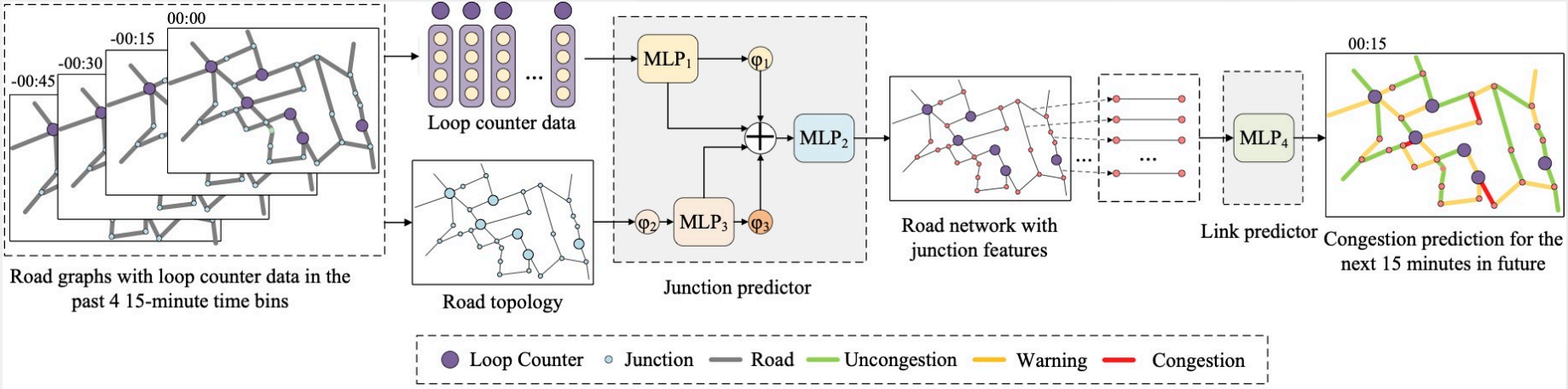
Loss function: masked cross-entropy loss

$$\ell(\hat{y}, y) = \sum_{n=1}^{N} \frac{1}{\Sigma_{n=1}^{N} w_{y_n} \cdot \mathbb{1}\{y_n \neq \text{ignore\_index}\}} l_n, \quad l_n = -w_{y_n} \log \frac{\hat{y}_{n,y_n} + \varepsilon}{\Sigma_{c=0}^{C-1} \hat{y}_{n,c} + \varepsilon} \cdot \mathbb{1}\{y_n \neq \text{ignore\_index}\}$$

Optimiser: AdamW

Learning rate: 3e-4

MLP-based GNN model

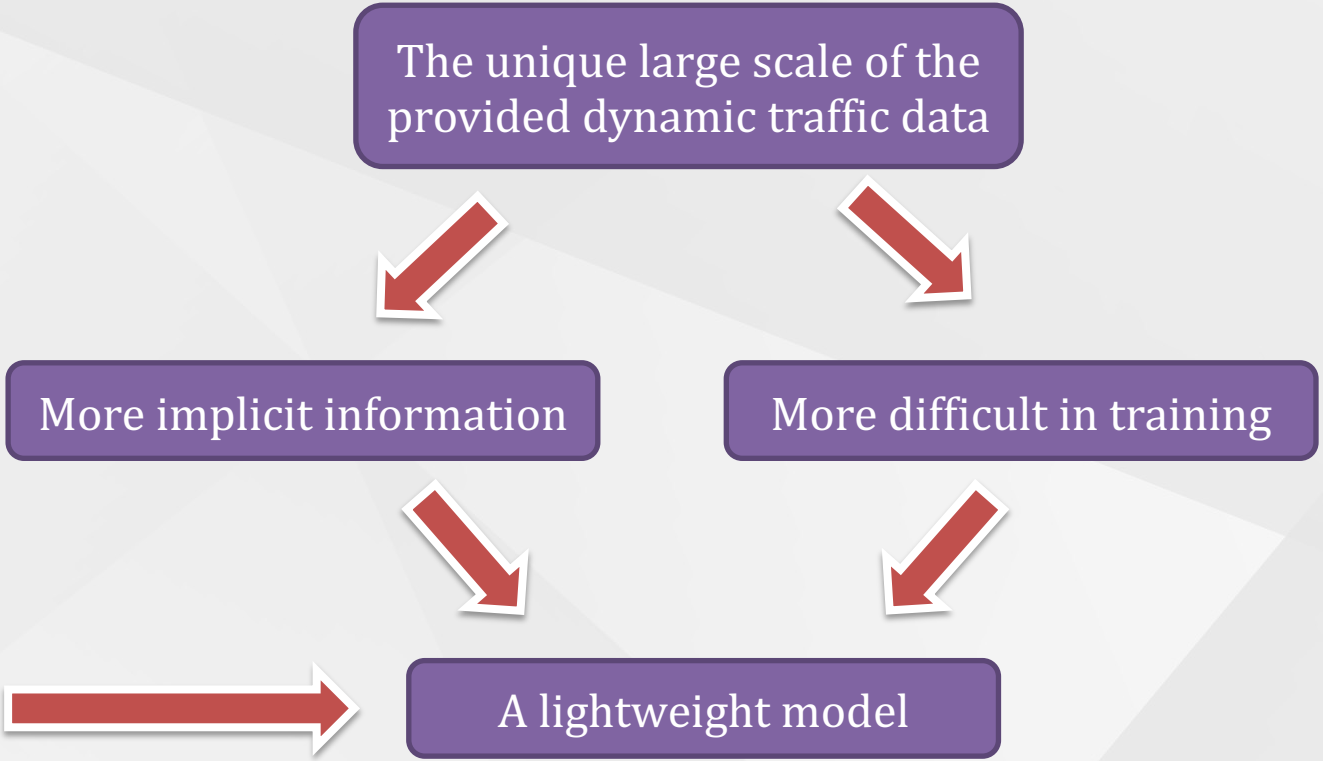


$$\mathbb{H}_{\mathrm{X}} = \mathrm{MLP}_1(\mathbb{X})$$
$$\mathbb{H}_{\mathrm{A}} = \mathrm{MLP}_3(\varphi_2 \mathbb{A})$$
$$\mathbb{H} = \sigma \mathrm{MLP}_2(\sigma(\mathbb{H}_{\mathrm{X}} + \mathbb{H}_{\mathrm{A}} + \varphi_1 \mathbb{H}_{\mathrm{X}} + \varphi_3 \mathbb{H}_{\mathrm{A}}))$$

$$\mathbb{C} = \sigma(\varphi_4(\mathbb{X}_{\mathrm{u}} \circ \mathbb{X}_{\mathrm{v}}))$$

Motivation

Inspired by NIPS 2021 paper: *"Large Scale Learning on Non-Homophilous Graphs: New Benchmarks and Strong Simple Methods"*



Core Competition Result

Score (Weighted Cross-Entropy cc)	Team
0.8431079388	ustc-gobbler
0.8496679068	Bolt
0.8504153291	oahciy
0.8560309211	GongLab
0.8736550411	TSE
0.8759126862	discovery
0.8778917591	**ywei**

Contribution

- We design a two-stream GNN architecture to tackle the congestion prediction challenge
- We show that a lightweight model can achieve good performance even when using a comparatively small amount of computational resources

Discussion and Future Work

- Utilising other state-of-the-art spatio-temporal forecasting models
- Further analysis of the model prediction results

Thank you!